

Operating Manual
Fast Diode Current Modulator MCM



Warning!
Risk of exposure of hazardous laser radiation
in combination with laser light emitting devices!

**Operating Manual
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Document: 10100555OM

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Date: 26.10.2017

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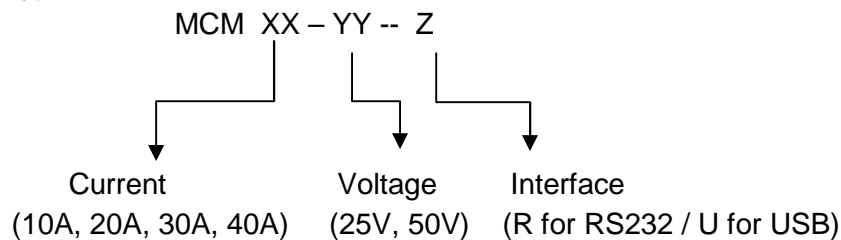
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1. Overview

1.1 General Description

The Fast Diode Current Modulator **MCM** is a linear modulator with excellent properties for driving arbitrary current waveforms into laser diodes. Current waveforms can be CW, pulsed, modulated or mixed with frequencies up to 80 kHz and currents up to 40 A for CW and 80 A for short pulsed waveforms.

Type code:



An internal pulse generator and an external trigger input generate fast and clean pulses by feeding in a DC voltage at the X2 input, even if the trigger signal has a bad waveform.

For achieving maximum performance it is required to mount the modulator as close as possible to the laser diode and to connect it with low inductance (e.g. short twisted cable). Conventional wires are not allowed, this will decrease performance significantly and may lead to an unstable operating.

A serial interface serves to configure, control and monitor the modulator.

Various user interfaces are available.

The modulator is small and compact and it is designed for mounting with low inductance at the laser diodes or for integrating it in laser diode modules.

Ask our support for more information and for important hints.

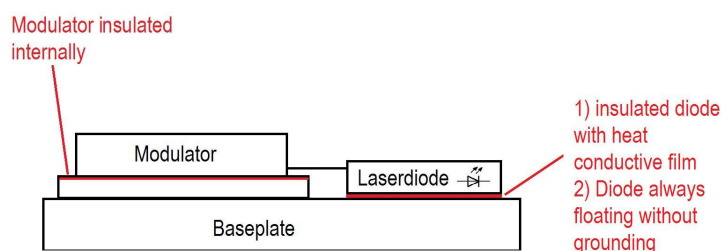
The modulator has two analogue inputs for the current set point, one input with 50 Ohm impedance and one input with high impedance. Both inputs respectively cover the full current range. Additionally via software control a CW-current (bias current) can be generated.

All set points are added and form the effective (modulated) current set point.

The user needs to make sure that the maximum current will not be exceeded.

The diode must be mounted floating;

Neither the cathode nor the anode is allowed to be grounded!



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1.2 Power Dissipation

Dynamic performance of the modulator normally increase with supply voltage, however the electrical power dissipation increase with supply voltage, too.

The recommended supply voltage for CW Operation is 2V above diode voltage and for fast pulsed / modulated operating 3V - 8V above diode voltage. The ideal supply voltage for the best dynamic behavior has to be tested during commissioning.

Simple formulas for calculating power dissipation:

Us	Supply Voltage (V)
Ud	Diode Voltage (V)
I _{dcw}	Diode Current CW (A)
I _{dpeak}	Diode Current peak value (A) (for sinusoidal and rectangle currents)
t _p	Pulse Duration (s)
f	Pulse Frequency (Hz)
PI	Power Dissipation (W)

For operating with CW current:

$$PI = (U_s - U_d) \times I_{dcw}$$

For operating with sinusoidal current:

$$PI = (U_s - U_d) \times (I_{dpeak} / 2)$$

For operating with rectangle current:

$$PI = (U_s - U_d) \times I_{dpeak} \times t_p \times f$$

For operating with sinusoidal current plus CW current:

$$PI = (U_s - U_d) \times ((I_{dpeak} / 2) + I_{dcw})$$

For operating with rectangle current plus CW current:

$$PI = (U_s - U_d) \times (I_{dpeak} \times t_p \times f + I_{dcw})$$

The calculating of power dissipation with arbitrary current waveforms is difficult, therefore one method for estimating power dissipation is to measure the temperature of the modulator.

1.3 Temperature Measurement

The modulator has a precise temperature measurement system inside.

The SA-TEMP output reflects the actual temperature in the range of 0 °C ... +80 °C.

Values of 60 °C are still not critical.

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1.4 General Instructions

Never run a negative current set point (effective current set point), this may lead to an overshoot if you alter the negative current set point to a positive current set point.

If you use a pulse signal generator or a function generator for the current set point, always disconnect it before you change any ranges. Some generators create high voltages or undefined signals if you change ranges, this may damage diodes and the modulator.

WARNING!

**There is a risk of exposure of hazardous laser radiation in combination with laser light emitting devices!
Be aware that you fulfill all safety requirements!**

2. Starting Up

We recommend the following procedure for starting up:

Step 1: Precautionary Measures

Avoid personal static charge!

Switch off all power supplies for the laser driver.

Step 2: Preparation

For further steps also see wiring diagrams below.

In order to avoid ground loop it is highly recommended to split “analog” ground and “digital” ground.

Disconnect the diode and short-circuit the output of the modulator:

connect X6- to X7+ via short cable or clamp.

Connect an oscilloscope at the X3 (SA-DCACT) current monitor output.

Connect the power supply for the diode at X4- (GND) and X5+.

Check correct cabling!

Step 3: Pre-Testing

For all types MCM xx-yy-z:

Adjust supply voltage approx. 2V - 3V above diode voltage.

Turn on the power supply for the diode.

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Step 4: Configuration

Connect the modulator with a PC, notebook or tablet.

(Remark: at the moment only USB is possible)

See separate Operating Manual CSMCM (Control Software for MCM).

Enable the modulator (connect X1-3 to Ground) and watch the X3 current monitor output.

For all following steps:

Be aware of maximum diode current and maximum allowed power dissipation!

See specifications for modulator and diode.

Set the BIAS (Threshold) Current to 1/10 of maximum CW current via Control Software CSMCM.

(Example for MCM 10-25: maximum CW current is 10A, set the BIAS (Threshold) current to 1A.)

You must see 1/10 of the maximum current value on the oscilloscope (DC current).

Turn back the BIAS (Threshold) Current to "Zero".

Connect X1-2 (CA-DCSP2) with adjustable DC power supply or function generator.

Supply X1-2 with 500mV DC.

You must see 1/10 of the maximum current value on the oscilloscope (DC current).

Disconnect X1-2.

Connect X2 (CA-DCSP1) with adjustable DC power supply or function generator.

If you use the analog input X2 connect X1-7 (CD-TRIGG) with 3,5V ... 6V, preferred 5V.

Supply X2 with 50mV DC.

Remark:

When using the analog input X2 (CA-DCSP1) the set point only acts when the trigger input X1-7 is HIGH.

You must see 1/10 of the maximum current value on the oscilloscope (DC current).

Disconnect X2.

Feed in a TTL-square wave or a CMOS-square wave with a pulse length of approx.

50 μ s and a repetition rate of approx. 100 Hz at X1-7 (CD-TRIGG).

Feed in a positive DC-voltage which represents approx. 50% of maximum allowed diode current at X2 (see detailed signal description for CA-DCSP1).

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The X3-signal must be a square wave with a pulse length of 50 μ s, a repetition rate of 100 Hz and an adequate amplitude of the diode current (see detailed signal description for SA-DCACT).

Switch off all power supplies and function generator.

Step 5: Commissioning

If the X3-signal is correct, disable the modulator (X1-3).

Remove the short-circuit at X6 - X7 and connect the diode.
Connect the diode with short, twisted pair cables.

Recommendation:

Thin parallel metal sheets (striplines) support the fast dynamic performance.
Adjust the supply voltage for the diode according to recommended operating diode voltages.

Enable the laser driver at X1-3.

Adjust set points via Control Software CSMCM, analog input X2 and / or analog input X1-2.

For generating pulses use the trigger input X1-7 (is effective only on analog input CA-DCSP1 at X2).

Be aware of the maximum diode current!

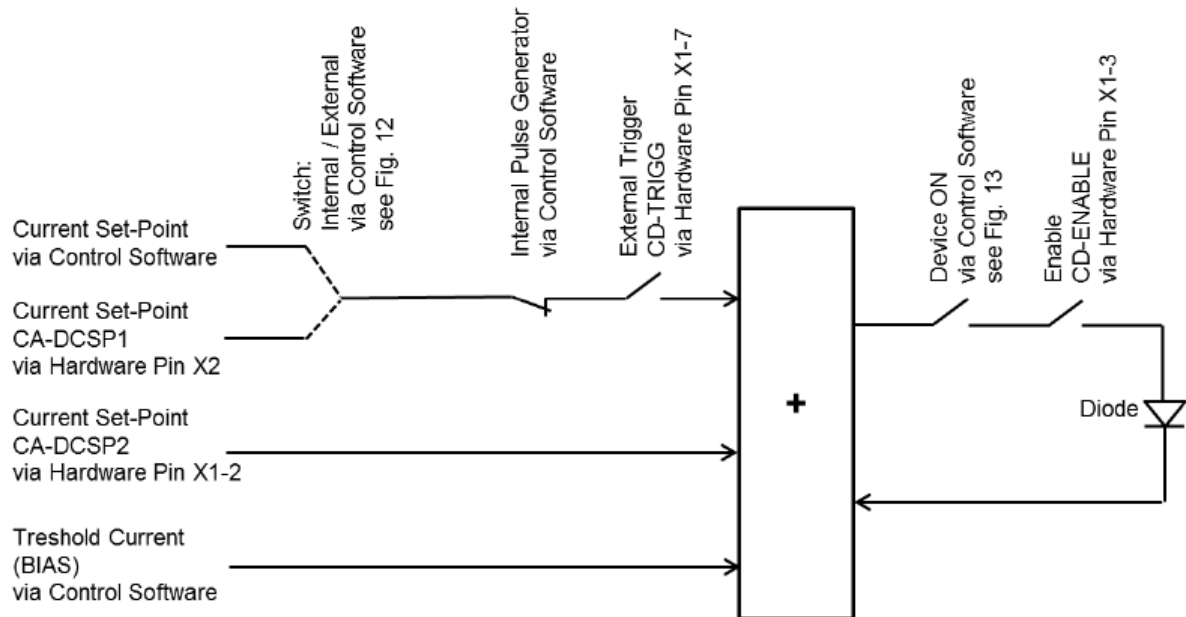
Be aware of the maximum allowed power dissipation of the modulator!

Recommendation:

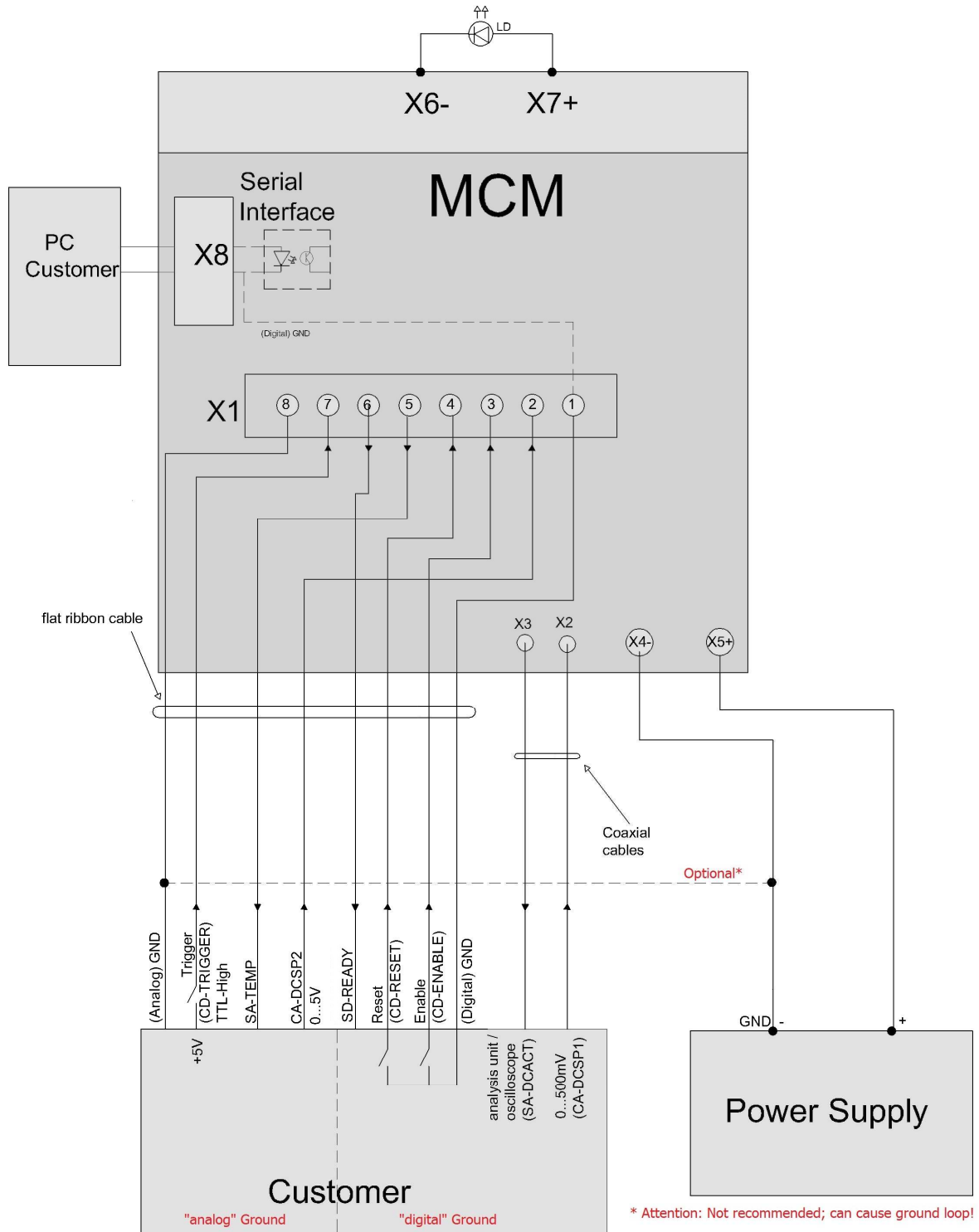
The recommended supply voltage for CW Operation is 2V above diode voltage and for fast pulsed / modulated operating 3V - 8V above diode voltage. The ideal supply voltage for the best dynamic behavior has to be tested during commissioning carefully.

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The following diagram shows the multi-functional combination of control functions realized with hardware signals and software control including the use of the internal pulse generator and the external trigger input:



3. Wiring Diagram for MCM



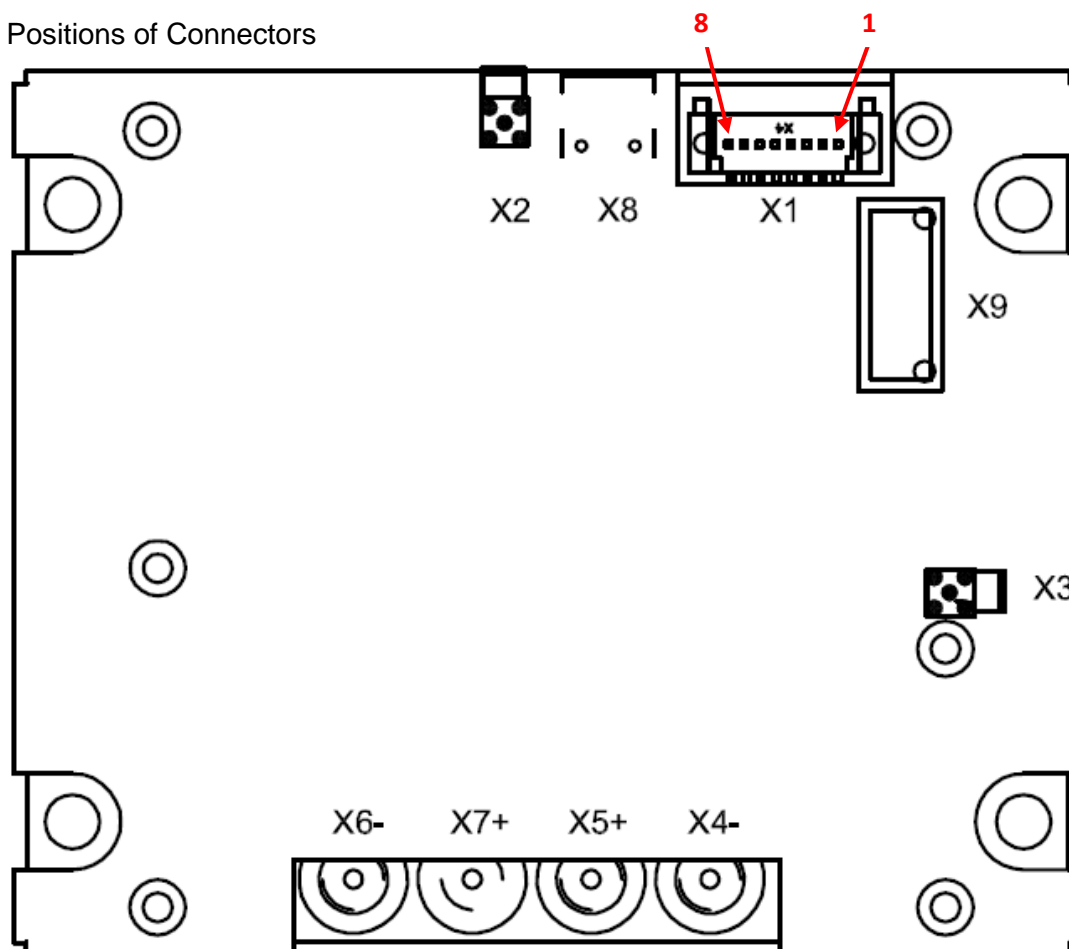
4. Indicators, Connectors and User Interfaces

4.1 Indicator Elements

Flashing Red and Green LED for indicating the data transfer from / to Control Software CSMCM.

4.2 Connectors

Positions of Connectors



- X1 8-pole single row male connector for control signals, status signals and Ground
- X2 female coaxial jack MMCX for current set point 1
- X3 female coaxial jack MMCX for actual current (current monitor)
- X4- connection bolt & 5 mm with female thread M4 for Supply Voltage Minus
- X5+ connection bolt & 5 mm with female thread M4 for Supply Voltage Plus
- X6- connection bolt & 5 mm with female thread M4 for laser diode cathode
- X7+ connection bolt & 5 mm with female thread M4 for laser diode anode
- X8 Serial Interface 1
- X9 Serial Interface 2

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X1 Control Port

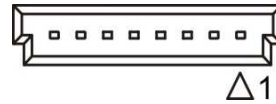
8-pole single row male connector

Manufacturer: ERNI Part number 214014

Mating plug:

8-pole single row female connector

Manufacturer: ERNI Part number 224396



CA=Control Data Analog

CD=Control Data Digital

SA=Status Data Analog

SD=Status Data Digital

Inputs Control Port X1		
Pin	Name	Function
1	GND	Signal Ground for digital signals
2	CA-DCSP2	Diode Current Set Point 2
3	CD-ENABLE	Enable
4	CD-RESET	Reset
7	CD-TRIGG	Trigger
8	GND	Signal Ground for analog signals
Outputs Control Port X1		
Pin	Name	Function
5	SA-TEMP	Temperature
6	SD-READY	Ready

X2 Control Port

Female coaxial jack MMCX

CA-DCSP1

Diode Current Set Point 1



X3 Current Monitor Port

Female coaxial jack MMCX

SA-DCACT

Diode Current Actual



X4-

Connection bolt \varnothing 5 mm with female thread M4

Supply Voltage Minus for the laser driver MCM

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X5+

Connection bolt \varnothing 5 mm with female thread M4
Supply Voltage Plus for the laser driver MCM

X6-

Connection bolt \varnothing 5 mm with female thread M4
Laser Diode Cathode

X7+

Connection bolt \varnothing 5 mm with female thread M4
Laser Diode Anode

X8

Serial Interface 1 for USB Interface Mini B
Option: RS 232 via RS-232 Interface Cable (Part Number 10385263)

X9

Serial Interface 2

4.3 Signal Description

CA-DCSP1 (X2)

Control Analog - Diode Current Set Point 1
Analog input 0 ... 500 mV, input impedance 50 Ohm
0 ... 500 mV corresponds to a diode current of 0 ... max current CW.
0 ... 1000mV corresponds to a diode current of 0...max pulsed current (only for short pulses allowed!)
Max power dissipation must be considered!

CA-DCSP2 (X1-2)

Control Analog - Diode Current Set Point 2
Analog input 0 ... 5 V, input impedance 10 kOhm
0 ... 5 V corresponds to a diode current of 0 ... max current
Max power dissipation must be considered!

Diode Current Set Point 1, Diode Current Set Point 2 and the current value of the bias current are added internally and build the effective current set point.

The user needs to make sure that the maximum current will not be exceeded.

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SA-DCACT (X3)

Status Analog - Diode Current Actual

Analog output 0 ... 2500 mV (off-load voltage), reflects the actual diode current.

0 ... 2500 mV corresponds to a diode current of 0 ... max current CW.

0 ... 5000 mV corresponds to a diode current 0 ... max pulsed current (only for short pulses allowed!)

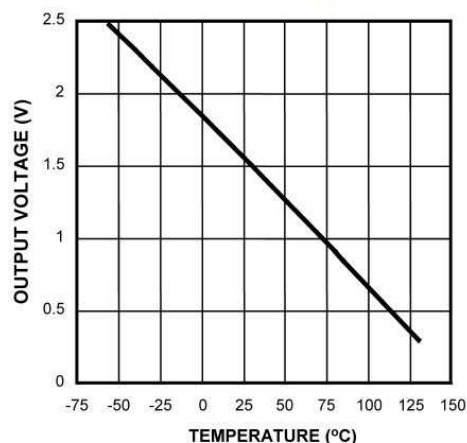
SA-TEMP (X1-5)

Status Analog - Temperature

The analog output reflects the actual temperature of the modulator.

1863,9 mV corresponds to 0 °C, 919 mV corresponds to +80 °C .

Output Voltage vs Temperature



Temperature (T)	Typical V_O
130°C	303 mV
100°C	675 mV
80°C	919 mV
30°C	1515 mV
25°C	1574 mV
0°C	1863.9 mV
-30°C	2205 mV
-40°C	2318 mV
-55°C	2485 mV

CD-ENABLE (X1-3)

Control Digital - Enable

Digital open-collector input, High if left open.

A Low-Signal or pulling the input to GND enables diode current.

CD-RESET (X1-4)

Control Digital - Reset

Digital open-collector input, High if left open

A Low-Signal or pulling the input to GND resets the modulator if there was an error (maximum allowed current or power or power supply exceeded or excessive temperature)

CD-TRIGG (X1-7)

Control Digital - Trigger

Digital TTL input (3,5V ... 5V) controls the current set point 1 (CA-DCSP 1) signal at X2.

A logic High-level puts through the current set point 1 signal to the modulator,

a logic Low-level inhibits the current set point 1 signal.

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SD-READY (X1-6)

Status Digital - Ready

Digital open-collector output, High if there are no errors.

5. Internal Pulse Generator

The internal pulse generator acts on set point input CA-DCSP 1 (X2).

The pulses as well the pulse pauses can be adjusted in the range from 1,055µs ... 4394.71µs.

(At the moment: minimum 15 µs)

More details and configuration see chapter 2.3 in manual Control Software CSMCM.

6. Control Software CSMCM, Serial InterfacesThe **Control Software CSMCM** (Control Software for MCM) is used for configuration, controlling and monitoring of the MCM modulators.

Please ask for separate manual.

For details of **Serial Interfaces** please ask for separate descriptions for:

- Serial Interface for Diode Driver MCM
- DLL Interface RS 232 for Diode Driver MCM
- DLL Interface USB for Diode Driver MCM

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7. General Specification

Diode current CW	0 ... 40 A
Diode current pulsed	0 ... 80 A (short pulses)
Diode voltage	0 ... 46 V
Output power	1840 W max
Power dissipation	120 W max allowed
Supply voltage	6 ... 50 V *)
Supply current	41 A max
Rise time	6 μ s
Fall time	6 μ s
Frequency bandwidth (set point 1)	DC ... 93 kHz max
Frequency bandwidth (set point 2)	DC ... 68 kHz max

Cooling required

Operating temperature range 0 ... +45 °C

Dimensions 87 x 72 x 41 mm

Weight 202 g

*) Recommended supply voltage: CW operation:
2V above diode voltage

Pulsed/Modulation operating:
3V - 8V above diode voltage

Final values have to be tested during
commissioning.

More specification information see respective data sheet.

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8. Ordering Codes**8.1 Modulators MCM**

The ordering code depends on the serial user interface:

Type	Interface	Ordering code
MCM 10-25-U	USB	10100555
MCM 10-25-R	RS-232	10100570
MCM 20-25-U	USB	10100556
MCM 20-25-R	RS-232	10100571
MCM 30-25-U	USB	10100557
MCM 30-25-R	RS-232	10100572
MCM 40-25-U	USB	10100558
MCM 40-25-R	RS-232	10100573
MCM 10-50-U	USB	10100560
MCM 10-50-R	RS-232	10100575
MCM 20-50-U	USB	10100561
MCM 20-50-R	RS-232	10100576
MCM 30-50-U	USB	10100562
MCM 30-50-R	RS-232	10100577
MCM 40-50-U	USB	10100564
MCM 40-50-R	RS-232	10100578

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8.2 Scope of Delivery

Fast Diode Current Modulator

Part Number see table above

8-pole single row female connector (ERNI)

Part Number 10883510

8.3 Accessories

Buffer Capacitor

Part Number 10231091

Cables

Ribbon cable, 8pole with ERNI plug, 1m

Part Number 10385370

Ribbon cable, 8pole with ERNI plug, 3m

Part Number 10385371

USB Interface Cable

Part Number 10385120

RS-232 Interface Cable

Part Number 10385263

RS-232/ USB 2.0 Adapter

Part Number 10385264

Coax cable, one MMCX plug, one BNC plug, 0,5m

Part Number 10385372

Coax cable, one MMCX plug, one BNC plug, 1m

Part Number 10385373

Coax cable, one MMCX plug, one BNC plug, 2m

Part Number 10385374

Coax cable, one MMCX plug, one BNC plug, 3m

Part Number 10385375

Coax cable with MMCX plugs on both sides, 0,5m

Part Number 10385376

Coax cable with MMCX plugs on both sides, 1m

Part Number 10385377

Coax cable with MMCX plugs on both sides, 2m

Part Number 10385378

Coax cable with MMCX plugs on both sides, 3m

Part Number 10385379

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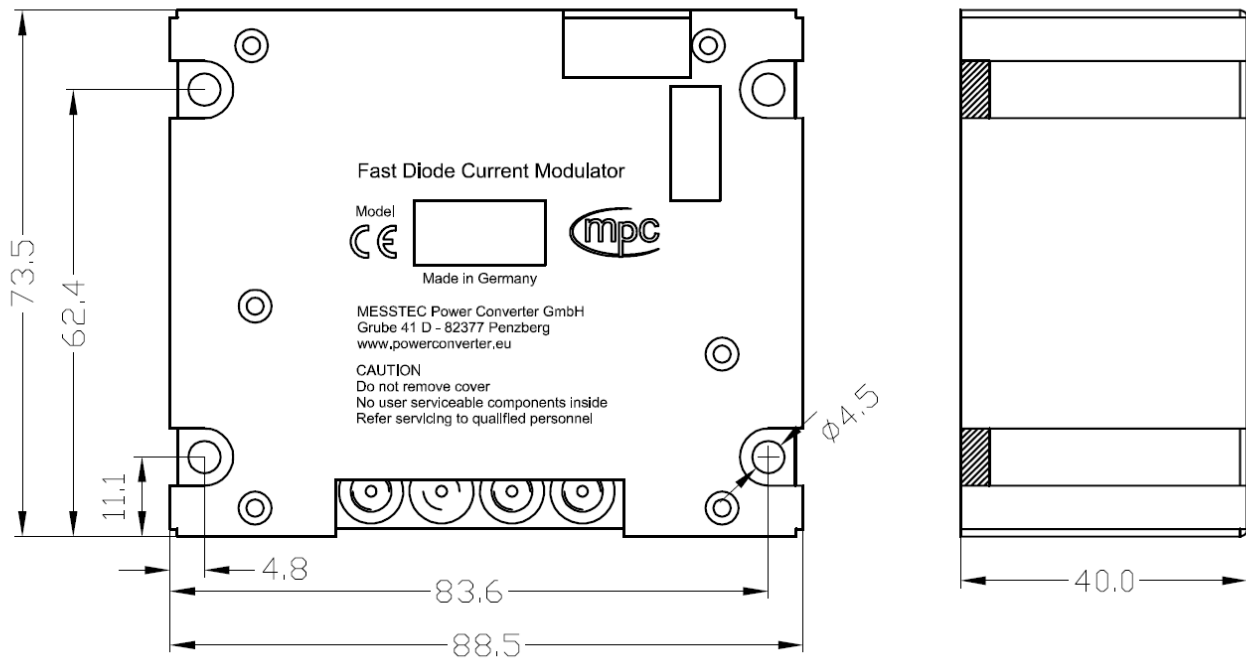
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9. Section Drawing

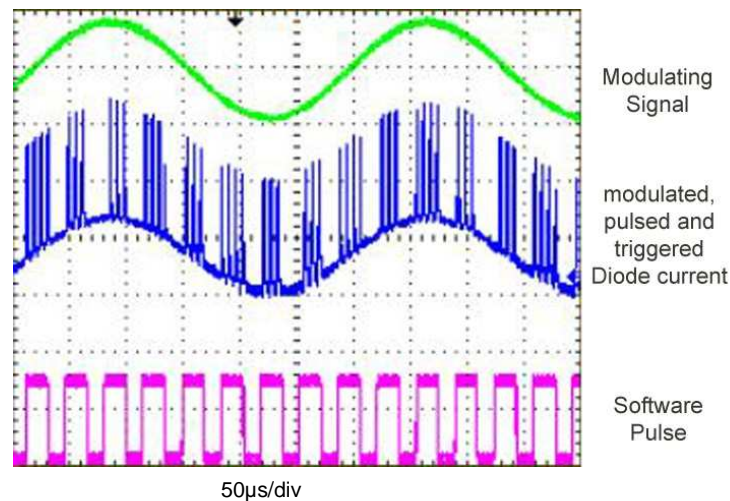
Dimensions (in mm)



10. Example Set Points, Diode Current Curves

The modulator has two analogue inputs for the current set point, one input with 50 Ohm impedance and one input with high impedance. Both inputs respectively cover the full current range. Additionally via software control a CW-current (bias current) can be generated. All set points are added and form the effective (modulated) current set point.

Example for overlaying modulated, pulsed and triggered set points:



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Technical subjects to change without notice.